Appendix: Claims after amendment

1) A thin-disk optical coupling element comprising:

an entrance aperture;

a beam turning element;

a waveguide array; and

an exit aperture,

said entrance aperture comprising a planar annular region of a bottom surface of said thin-disk,

said beam turning element formed in or on said thin-disk is arranged to redirect beams incident substantially orthogonal thereon in a radially inward direction towards said waveguide array,

said waveguide array is formed in a central or inner portion of said thin-disk, the waveguide array comprising a plurality of pie-wedge shaped members, and

said exit aperture being at least one surface whereby light beams from said waveguide array passes there through and exits the thin disk at an appreciably higher energy density than the beams energy density at entry to the thin-disk.

2) A thin-disk optical coupling of claim 1, said beam turning element is further comprised of a grating of periodic structures arranged with circular symmetry, said structures being disposed on a thin-disk surface opposite the surface in which the entrance aperture lies.

3) A thin-disk optical coupling of claim 2, said grating being a cylindrically symmetric blazed type grating formed of a plurality of surface relief repeat structures in a top surface of said thin-disk, each repeat structure forming a concentric circle having a radius different each of the other repeat structures.

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4) A thin-disk optical coupling of claim 2, said grating being a symmetric phase type grating characterized as a hologram optical element.

5) A thin-disk optical coupling of claim 1, wherein each of said entrance and exit apertures, said beam turning element, and said waveguide array being symmetric about a system symmetry axis,

said entrance aperture is polished smooth, the aperture is between .5 and 5 cm^2, having an opaque void at its center, and

said exit aperture is comprised of a plurality of curved surfaces lying in a cylinder.

6) A thin-disk optical coupling of claim 1, wherein said waveguide array comprised of pie-wedge elements is further defined as having side surfaces and air slits between those side surfaces to provide interfaces operable for promoting total internal reflections within the pie-wedge elements, said side surfaces being planar polished surfaces whereby light beams falling thereon remain within the pie-wedge elements and continue to propagate generally towards the system symmetry axis.

7) A thin-disk optical coupling of claim 1, further comprising a mirror element; said mirror element being coupled with said waveguide array whereby light from the waveguide array falls upon the mirror element and is reflected toward said exit aperture.

8) A thin-disk optical coupling of claim 7, said mirror is a conic surface formed directly on the thin-disk element and concentric with the system axis.

9) A thin-disk optical coupling of claim 8, said exit aperture is formed on the top surface of the thin-disk element, the opposite surface with respect to the entrance aperture, whereby light leaves the thin disk on the axis and upwardly away from a tissue test site.

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10) A thin-disk optical coupling of claim 1, said coupling comprises an entrance to exit aperture ratio greater than 3.

14) Optical in-vivo monitoring systems for monitoring states of living tissues comprising:

an illumination source;

an optical coupling element; and

a photodetector,

said illumination source arranged to transmit a beam into a tissue test site, said optical coupling element concentric therewith said illumination source, being arranged to receive modulated light from the tissue test site and transmit received light at a sufficiently higher energy density to said photodetector,

said optical coupling element is further defined as a thin-disk optical coupling element comprising: an entrance aperture; a beam turning element; a waveguide array; and an exit aperture, said entrance aperture comprising a planar annular region of a bottom surface of said thin-disk, said beam turning element formed in or on said thin-disk is arranged to redirect beams incident substantially orthogonal thereon in a radially inward direction towards said waveguide array, said waveguide array is formed in a central or inner portion of said thin-disk, the waveguide array comprising a plurality of pie-wedge shaped members, and said exit aperture being at least one surface whereby light beams from said waveguide array passes there through and exits the thin disk at an appreciably higher energy density than the beams energy density at entry to the thin-disk.

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